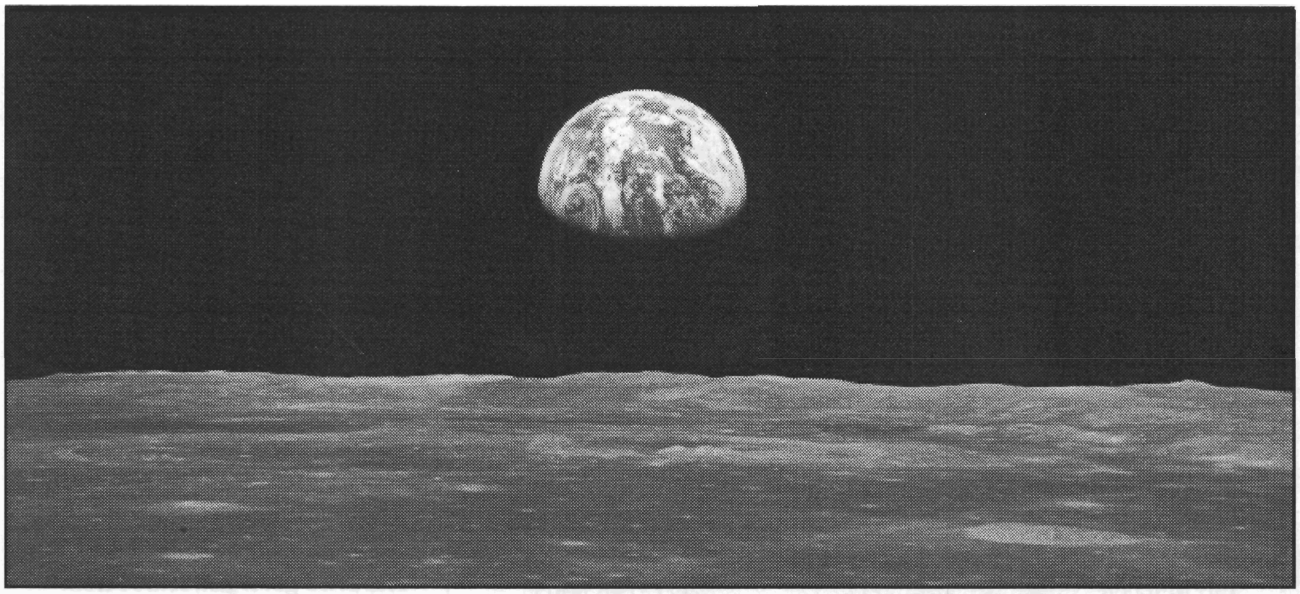
LUNAR *NEWS*

No. 57 July 1994



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Lunar News Mission

The purpose of "Lunar News" is to provide a newsletter forum for facts and opinions about lunar sample studies, lunar geoscience, and the significance of the Moon in solar system exploration.

Editor's Notes

"Lunar News" is published by the Office of the Curator, Solar System Exploration Division, Johnson Space Center of the National Aeronautics and Space Administration. It is sent free to all interested individuals. To be included on the mailing list, write to the address below. Please send to the same address any comments on "Lunar News" or suggestions for new articles.

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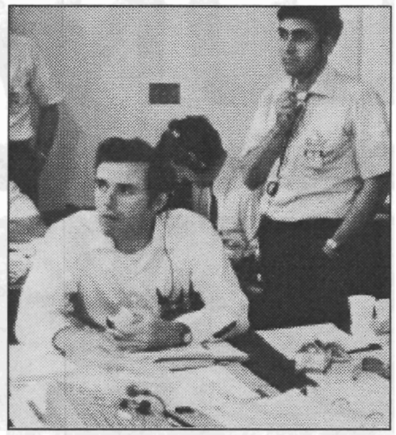

Young Dr. Phinney (seated, center) in the science "back room" during Apollo. Standing at the right is Apollo 17 astronaut, Jack Schmitt.

Bill Phinney Retires

Dr. William C. Phinney, our Associate Curator of Lunar Samples and an internationally respected geologist, retired from NASA service on May 3, 1994. Bill joined NASA in 1970 as Chief of the newly established Geology Branch, which had as its mission, the geological training of Apollo astronauts and preliminary examination of the samples that the astronauts returned from the Moon. He led both field training and laboratory sample research and became widely recognized as a leader in comparative studies of rocks from the ancient crusts of the Earth and Moon.

After the Apollo program ended, Bill served in numerous leadership roles, including Chief of the Experimental Planetology Branch. Bill later moved into a nonsupervisory position in order to concentrate on his research. But when the lunar sample curatorial effort needed to fill a key vacancy in late 1992, Bill graciously answered the call as Associate Curator. In addition to his role as senior science observer for lunar sample processing, he successfully

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Jim Gooding
NASA/JSC

Curator's Comments

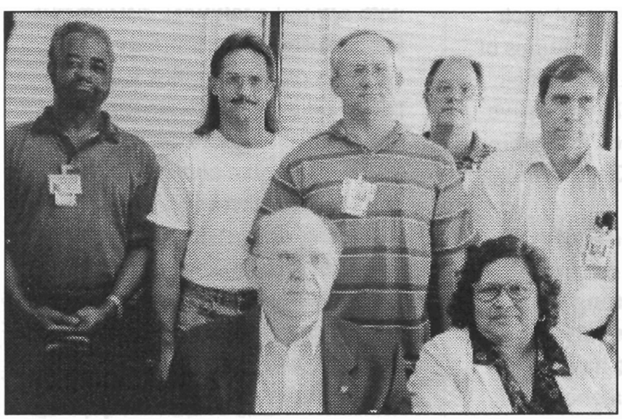
The Lunar Facility and Data Caretakers

The previous issue of Lunar News introduced to you the good people who prepare and package the lunar samples that go out into the world for research, education, and public display. But long before a lunar sample can be shipped, many exacting behind-the-scenes operations must be accomplished in the worlds of facilities and data management.

Extensive efforts are made to keep the lunar sample collection physically secure and environmentally uncontaminated. Jim Townsend directs our work to maintain the lunar sample building, and all of its clean rooms, as well as our liquid nitrogen tank farm (which supplies the high-purity nitrogen gas that protects the samples from Earth's atmosphere) and in-house, precision cleaning laboratories. Each tool and container is meticulously cleaned before it touches a lunar sample. Jim works closely with Ed Cornitius who supervises the technical team consisting of Jack Warren (clean room certification and trouble-shooting), Ron Bastien (electronic systems construction and maintenance), Terry Parker and Bill Williams (precision cleaning), and Rita Sosa (clean room house-keeping). The same team helps maintain our remote storage vault at Brooks Air Force Base. The technical operations team has nearly completed construction of a new freon-free precision cleaning system that will carry us forward into the next decades of lunar sample curation.

Equally arduous efforts are made to keep the genealogy of each lunar sample clearly recorded and updated, for the benefit of science, and to maintain a record of current locations for every lunar sample that is in NASA custody or that has been placed on loan to the world outside the lunar sample facility. In addition, continuous improvements are sought for our on-line electronic data bases that we make available to the public. Dale Browne leads our data group that includes Claire Dardano (computer system manager), Sue Goudie and Alene Simmons (sample shipping/receiving and file maintenance), and Judy Allton (document archivist). The data team is currently establishing a new workstation that will be used to electronicize, onto optical disks, the voluminous sample-processing notes and photographs that we, and our predecessors, have accumulated since 1969.

As with the lunar sample caretakers introduced previously, our operations and data team members view their work not merely as a job but as a career. As they celebrate the 25th anniversary of the Apollo 11 mission, these teams believe that their work not only touches the past but also the future. ❑



Lunar Facility Caretakers
From left to right: Bill Williams, Ron ι, Terry Parker, Jack Warren, and Ed Cornitii ted in front: Jim Townsend, and Rita Sosa.

Lunar Data Caretakers
From left to right: Alene Simmons, Dale Browne, and Judy Allton. Seated in front: Claire Dardano, and Sue Goudie.

Phinney's Retirement
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completed a thorough review and upgrade of our reference thin-section library.

Bill's scientific accomplishments have been acknowledged by his peers through commendations too numerous to list here. His exceptional achievements have been formally recognized by NASA, the Geological Society of America, and the Minnesota Academy of Sciences.

Even with his remarkable scientific distinctions, Bill was just as appreciated, if not as well known, for his service as chairman of the NASA scholarship committee which annually awarded privately endowed college scholarships to high-achieving children of NASA employees across the agency. We trust that his stewardship of higher education is not finished and we expect that some lucky college or university faculty and student body may benefit more directly from Bill's knowledge in the future. ❑

A Man on the Moon: The Voyages of the Apollo Astronauts by Andrew Chaikin (670 pages, Viking) is now available in bookstores. Chaikin's narrative takes the reader along with the astronauts as they encounter intense competition for flights, the rigors of training, and the incredible experience of journeying to another world and back. He also describes the conversion of test pilots into scientific observers, and their quests for geologic discoveries at Hadley, Descartes, and Taurus-Littrow. Finally, the astronauts express their thoughts, looking back 25 years later. Several of the astronauts have called this book the definitive account of their missions. ❑

25 Years of Curating Moon Rocks

by Judy Allton
Lockheed Engineering & Sciences Company

Twenty-five years ago, rocks from the Moon were delivered to a laboratory in Houston that was a marked contrast to the methodical, almost serene laboratory in which the Moon rocks are curated today. In July 1969, action in the Lunar Receiving Laboratory was intense. Technicians working in the gloved-cabinets had scientists excitedly looking over their shoulders for a first glimpse of the rocks from the Moon. The scientists had the media eagerly awaiting some pronouncement about the appearance and composition of the samples.

Elbert A. King, the first Lunar Sample Curator, reported "The moment was truly history, but there was little we could observe or say. We counted the rocks and described the size and shape of each piece, but they looked like lumps of charcoal in the bottom of a backyard barbecue grill. The pervasive dark lunar dust obscured everything for the time being." (King, 1989).

Even reporting the results of chemical analysis was hurried. S. Ross Taylor recalls getting lunar samples about noon on July 29th knowing that he would have to produce the results of a good chemical analysis by emission spectroscopy for a press conference at 4:00 p.m. He carried out this analytical work behind the biological barrier, working on the sample inside of a nitrogen cabinet. Adding to the tension was the surprise discovery of 5000 ppm Cr in the Apollo 11 sample which obscured the primary calibration lines, so other lines had to be hastily substituted.

As part of advanced preparations in 1964, Elbert King and Donald A. Flory proposed a concept for a small 10-square-meter sample receiving laboratory in which sample containers could be opened and their contents repackaged under high vacuum for distribution to scientists. Remotely controlled manipulators would be used in the sterile and chemically clean vacuum chamber. Encouraged, King and Flory expanded their idea in a second version, called a "sample transfer facility." In addition to the vacuum sample-handling chamber, a clean room with several analytical instruments for performing preliminary analyses on the samples was proposed to enable wise distribution of the samples (Compton, 1989). The plan continued to be embellished, incorporating measurement of short-lived radioactivity in samples and mass spectroscopic analysis of sample and container gases. Debate about the need for, and scope of, a lunar sample receiving facility uncovered a concern among science advisory groups that a greatly enhanced receiving and analytical facility would take much of the lunar science program out of the hands of a broad community of academic investigators. Some scientists

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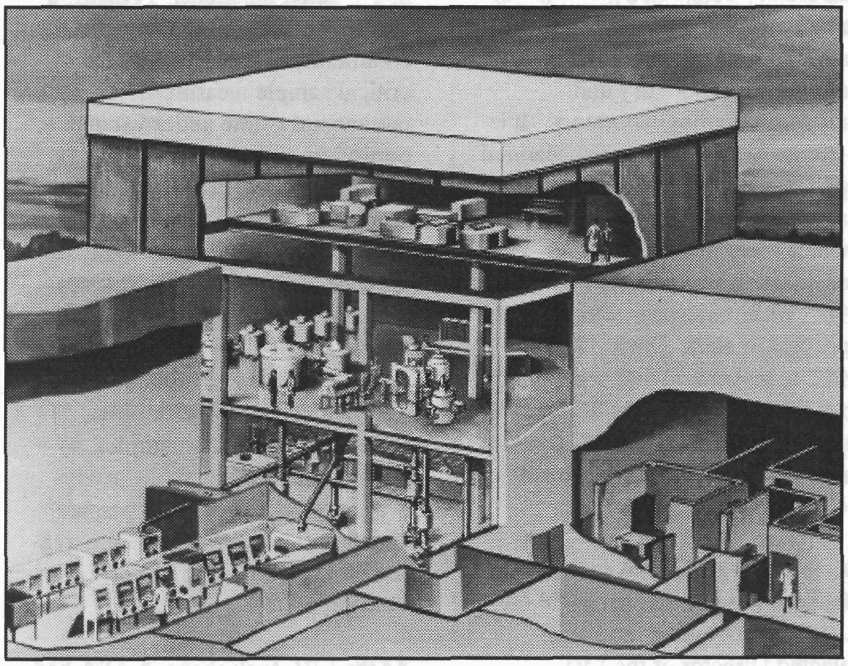
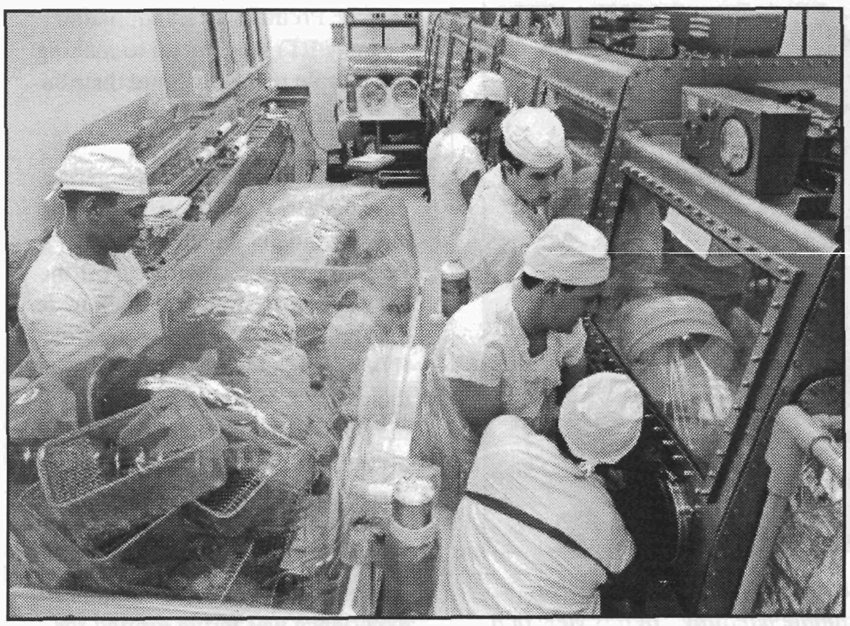


Artist's cutaway view of the Lunar Receiving Laboratory. The vacuum system was placed on the second floor. On the floor below, the quarantine bio-cabinet line and nitrogen cabinets for chemical/physical analysis were located. Above, on the third floor, was the mass spectrometry lab for analyzing gases emitted from samples and containers. The low level gamma-counting laboratory was buried 50 feet below ground. NASA S-67-687



In the crowded and hectic environment of the LRL bio-technicians conduct quarantine testing of lunar rocks and soils inside a line of nitrogen-filled cabinets. NASA S-69-25713

Apollo Lunar Surface Journal to Appear on CD-ROM This Year

By Eric M. Jones
Los Alamos National Laboratory
Los Alamos, New Mexico

The Apollo Lunar Surface Journal will be published by World Library, Inc. on four CD-ROMs. Each CD-ROM will include the annotated transcript, the mission report, the relevant checklists, a large selection of photos and drawings, the EVA audio tracks, and a selection of video clips. As described in Lunar News No. 55 (July 1993, p. 5-7), the Journal is meant to document for posterity the technical experiences and insights gained by the Apollo astronauts who explored the surface of the Moon in 1969-72.

The Apollo 17 Lunar Surface Journal will be the first one released and we are currently assembling all of the material. I wish I could predict a release date, but can't. Sometime in calendar 1994, we all hope. Work on the text for the second disk — which will combine Apollos 11, 12, and 14 — is well underway and I would expect its release before the middle of 1995. Disks for Apollos 15 and 16 might make it out at six-month intervals thereafter.

If you would like further publication details as they become available, please contact Eric Jones by e-mail at honais@vega.lanl.gov. ❑

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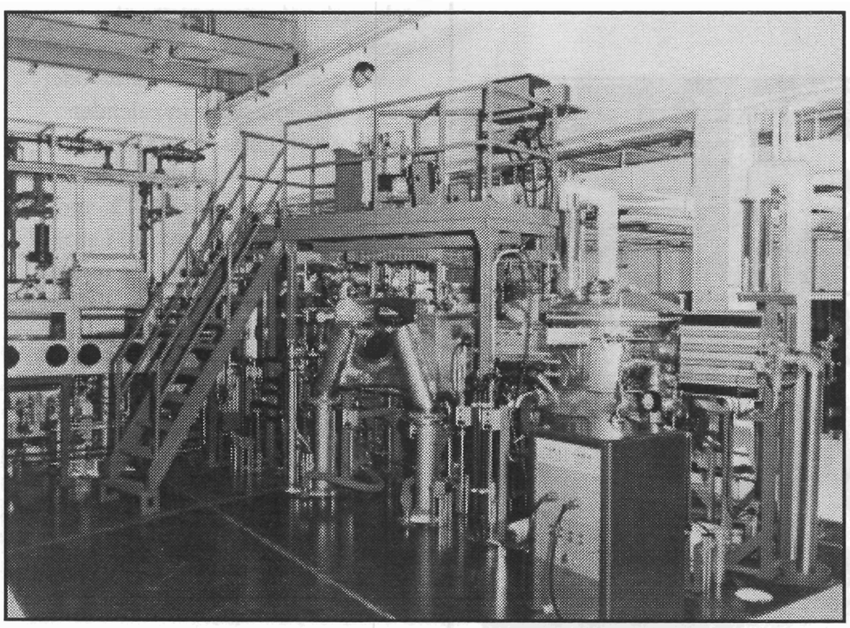
desired a facility functioning merely to pass samples on to investigators and not to store samples. In 1965 a committee of the Space Science Board reviewed the need for a lunar sample receiving laboratory and recommended a laboratory of restricted scope. This committee also raised the question of quarantine for lunar samples until they proved to be biologically harmless.

"But as plans for managing the samples developed, NASA came under pressure from space biologists and the U.S. Public Health Service to protect earth against the introduction of alien microorganisms that might exist in lunar soil. What would have been a small laboratory designed to protect lunar samples against contamination grew into an elaborate, expensive quarantine facility that greatly complicated operations on the early lunar landing missions." (Compton, 1989).

The $7.8 million Lunar Receiving Laboratory comprised 8,000 m^2 of lunar receiving laboratory, biological facilities, crew isolation area, gas analysis laboratory and radiation-counting laboratory. It is a tribute to the focus of the Manned Spacecraft Center (MSC, precursor name of Johnson Space Center) management that the building construction was completed in 1967, within one year after approval to start. During 1967 MSC management was struggling to recover from the Apollo capsule fire, that had killed three astronauts on the ground, and fly the first of 14 Apollo spacecraft.

Dr. Peter R. Bell, from Oak Ridge National Laboratory, designed the LRL vacuum system and was selected Director of the LRL. Under him engineers and technicians labored mightily to install and checkout the sophisticated sample-handling vacuum system before the samples arrived.



Complex plumbing spanning 3 floors was required to operate the sophisticated vacuum system constructed for lunar sample handling. In this view of a nearly-completed vacuum system the sole set of vacuum gloves would be installed in the center, directly below the technician on the scaffold. NASA S-68-2382.

The Lunar Receiving Laboratory had 4 stated functions: 1) distribution of samples to the scientific community, 2) perform time-critical sample measurements, 3) permanently store under vacuum a portion of each sample, and 4) quarantine testing of samples, spacecraft and astronauts (McLane et al., 1967). In contrast, today the purpose of curation of extraterrestrial materials at Johnson Space Center is to 1) keep the samples pure, 2) preserve accurate historical information about the samples, 3) examine and classify samples, 4) publish information about newly-available samples, and 5) prepare and distribute samples for research and education (Office of the Curator, 1992).

As the LRL took shape, NASA had been encouraged to recruit members of the outside science community to participate in the oversight of the lab and in the preliminary examination of the samples. The expertise of many outsiders working on the Lunar Sample Analysis Planning Team (LSAPT) and the Preliminary Examination Team (PET) was crucial to making the sample processing and distribution operation work properly.

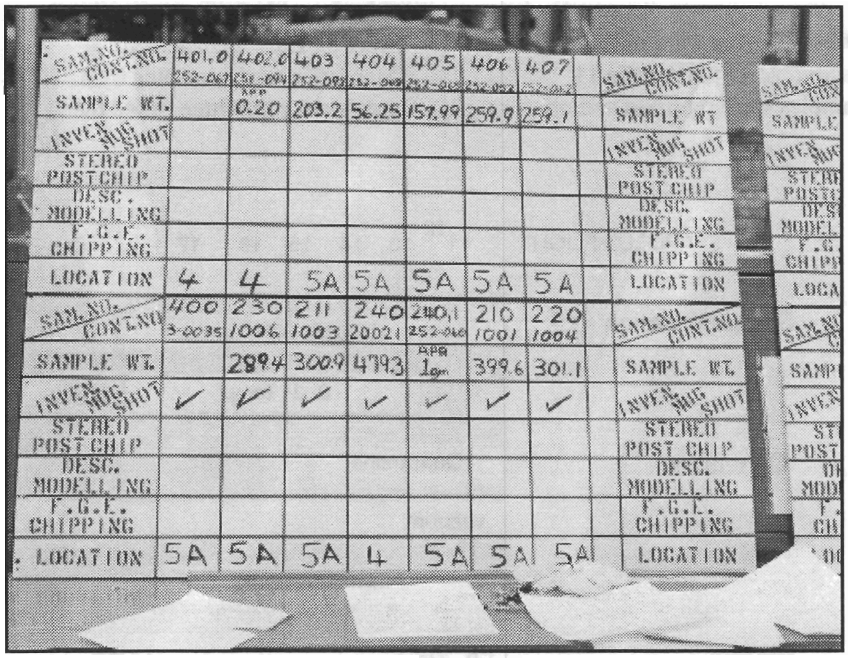
Scientists and technicians entering the laboratory had to strip off their clothes and put on lab clothing. Persons leaving had to strip off the lab clothes, shower, and walk nude through a lock bathed in ultraviolet (UV) light before they could put on their street clothes. Not many of the planetary scientists, astronauts or technicians took the quarantine seriously, figuring that the Moon already had a sterilization system of its own which included irradiation with solar UV. The quarantine experience was fertile ground for anecdotes, however—like the various versions of a local myth that a quarantine expert from Fort

Dietrich suggested using anthrax to test the effectiveness of the biological barrier. According to Elbert King someone did propose testing the barrier with Q-fever, a plan that had to be argued against in a managers' meeting.

When the rocks arrived, the sealed boxes were placed into the vacuum system known as the F-201. A technician working in spacesuit vacuum gloves manipulated the samples. The samples were observed and photographed in vacuum. Pieces of sample for examination or analysis were passed into cabinet lines containing nitrogen at 1 atmosphere. Working under separate management, the quarantine people fed lunar fines to mice, quail and other life forms, watching for ill effects and marveling that plants grew better in lunar soil than in quartz sand. Planetary scientists were unhappy about the amount of material which they viewed as wasted on these experiments and the extent to which quarantine diminished the focus on planetary research.

Meanwhile, PET worked behind the barrier to describe and analyze the samples in a cursory fashion so that the LSAPT could allocate samples wisely to Principal Investigators (PIs). LSAPT had responsibility for overseeing the scientific integrity of the samples and authorizing the preliminary examinations performed on the samples. At the beginning of the first mission, LSAPT members weren't even allowed into the LRL. Some PET members likened LSAPT to military Generals sitting in the chateau issuing orders to the PET troops in the trenches and being unappreciative of the difficulties of working very long hours in the frustrating environment of the quarantine.

Control panel for operation and monitoring of vacuum system. The back side of the vacuum system, showing the sample and tool storage carousels, is also visible. S-68-25206



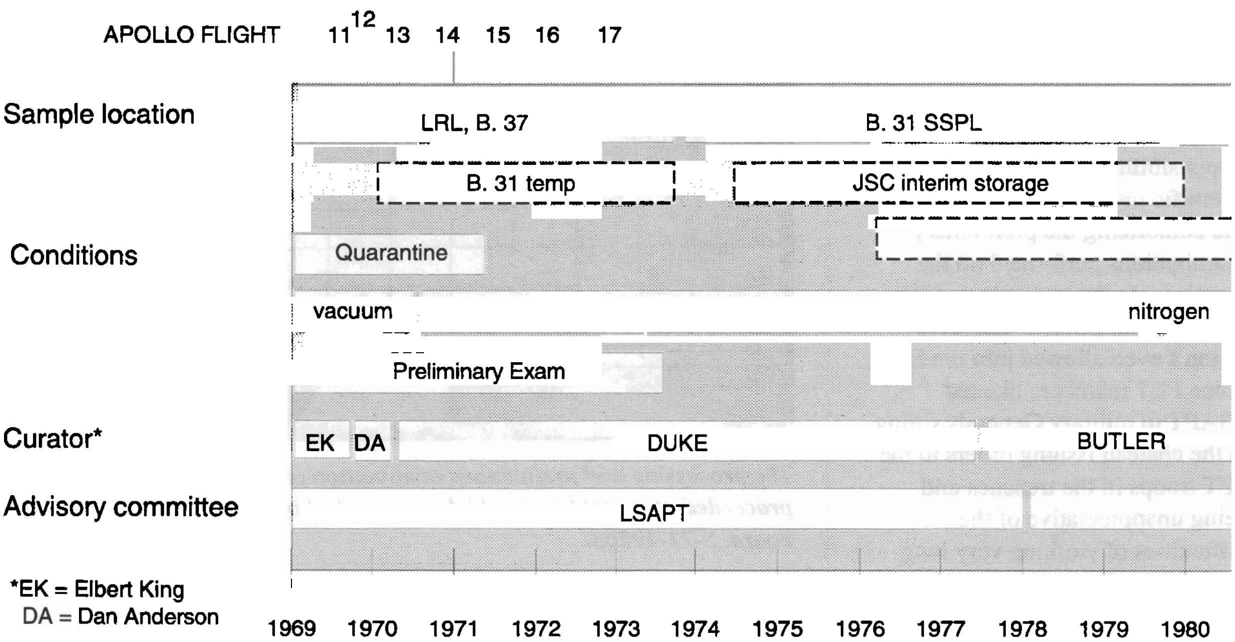
The processing and preliminary examination of newly-received lunar rocks proceeded at a rapid pace which was tracked inside the lab on an erasable board. S-71-19263.

Prior to Apollo 11, LSAPT had inspected the laboratory and advised high-level management of problems. However, during the original processing of Apollo 11 samples, LSAPT was permitted in the lab and saw first-hand the effects of quarantine protocols, the working of an imperfect vacuum system and the lack of attention to potential contamination of the samples by trace elements LSAPT saw immediate need for changes in LRL operations. Some changes were more easily made than others. Robert M. Walker hurriedly solicited the manufacture of clean plastic vials in St. Louis. Gerald J. Wasserburg, one of the very few who had experience working with rocks in clean rooms, fabricated stainless steel tools and containers in his laboratory. He bought stainless steel benches from butcher and food supply houses and had them air-freighted to Houston.

Other changes were not made so easily. After the Apollo 11 samples were returned and observed not to react with dry nitrogen, a consensus developed among LSAPT that handling the samples in nitrogen would be better than continuing with the vacuum system. Working in vacuum was extremely difficult. A rupture of the vacuum integrity was rather exciting and sucked all manner of contaminants (but no technicians) into the cabinet. Quarantine protocols called for dip tanks of peracetic acid and sodium hypochlorite for the purpose of sterilizing sealed sample containers by immersion. These tanks were placed in close proximity to sample handling operations. Astute members of LSAPT and NASA could also see that there was no room to process and store samples properly and that successful Apollo missions would be soon be arriving with more rocks and soils.

As advisors, LSAPT had no authority over quarantine and little effect on LRL management. Quarantine was mandated by a high-level committee called the Interagency Committee on Back Contamination comprised of representatives from NASA, the U.S. Public Health Service, Dept. of Agriculture and academia. LRL Director Peter R. Bell, also aware of the need for more processing and storage capability, was trying to get a second vacuum processing station funded. He worked hard on improving the reliability of the vacuum system in which he had invested so much of his energy. He was unwilling to give it up in the face of recommendations to process samples in nitrogen.

Four LSAPT scientists with a strong will to see that changes were made in the care of lunar samples took matters into their own hands. Known as the "Four Horsemen", Wasserburg, Walker, Paul Gast, and James R. Arnold finally took their cause to NASA Administrator Thomas Paine. The Four Horsemen got the attention of MSC's Director Robert Gilruth, who, after being taken on a nighttime inspection of the LRL, was very sympa-



thetic and supportive toward making improvements.

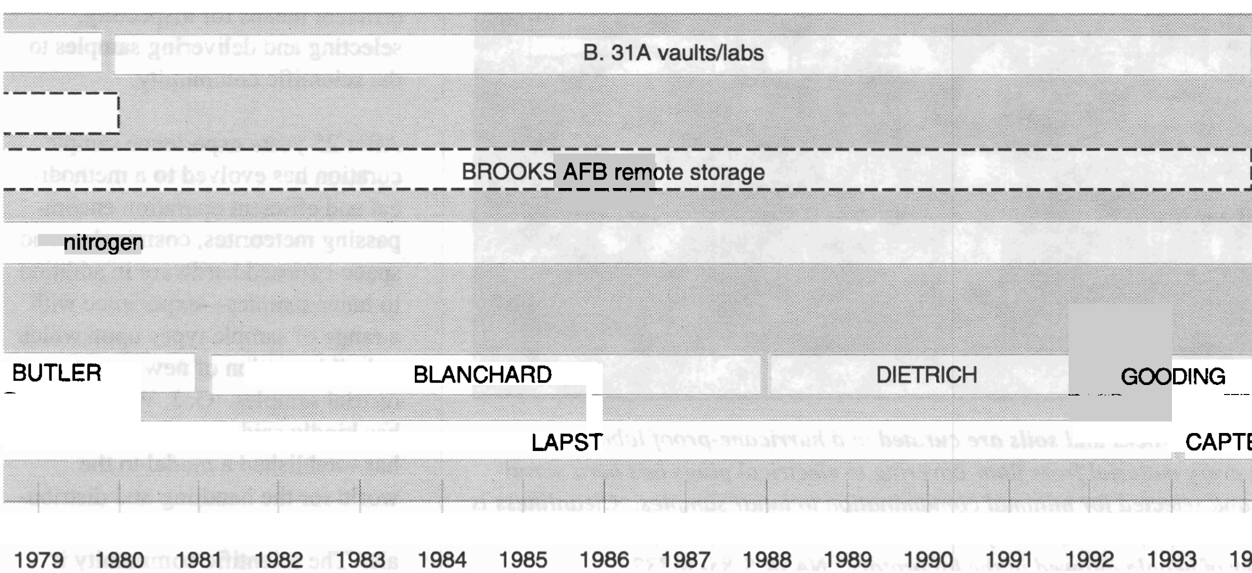
1970 was a year of changes. The explosion aboard Apollo 13 and the aborted lunar sample return gave the LRL time to catch up and rethink procedures. The appointment of Tony Calio as Director of Science and Applications, Paul Gast as Chief of Lunar and Earth Sciences Division, and Mike Duke as Curator resulted in progress on lunar sample preservation and careful documentation. The requirement to process samples in vacuum was dropped after Apollo 12. A small, temporary storage vault was quickly constructed in building 31. The following year quarantine was discontinued after Apollo 14, and this permitted more focused thinking about the sample processing and storage problem.

The solution to the problem was to construct the Sample Storage and Processing Laboratory (SSPL) by remodeling part of B. 31 at JSC for the purpose of storing samples securely and cleanly under nitrogen and preparing samples requested by PIs. Working in SSPL was considerably easier than in the LRL. Technicians and scientists merely donned clean room suits over their street clothes to enter the laboratory. Samples were handled in gloved cabinets. After the Apollo 17 PET was completed in 1973 all the samples were moved from the LRL into building 31. Except for the gas analysis and radiation counting labs, the LRL was abandoned to the biologists and doctors.

Under the curatorships of Mike Duke and Patrick Butler, documentation of sample handling was organized by sample number and standardized. Sample processing data collected from Apollo 15 onward was vastly improved. Materials touching lunar samples were strictly monitored and controlled. The excitement of opening new samples was maintained with the opening of drill stem and drive tube soil cores.

SSPL was known as the "pristine lab", for other areas in the building housed the collection of "used" samples returned by PIs at the conclusion of their studies (Returned Sample Processing Laboratory, RSPL) and the Thin Section Lab. By the mid-1970s thousands of samples were returned by PIs each year. To enhance the scientific use of the samples, updating of the sample catalogs to summarize published composition information was begun. In the absence of fresh sample cargos, the urgency of preliminary examinations relented and LSAPT was slightly redirected as the Lunar and Planetary Sample Team (LAPST).

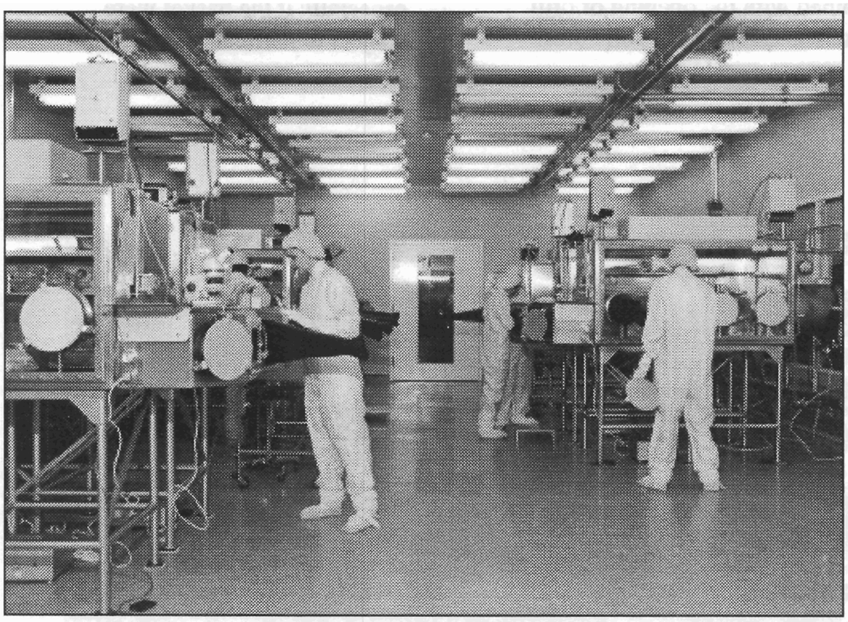
Lurking in the background was a concern that the lunar samples were vulnerable to natural disaster or military actions. A small fire and several ceiling water leaks in the pristine lab were reminders of this vulnerability. Not wishing to have "all the eggs in one basket", especially if the basket were subject to hurricanes, small



portions of the lunar sample collection were placed in three separate vaults at JSC while awaiting the completion of a remote storage facility at Brooks Air Force Base in San Antonio. One night in 1976 14% (by weight) of the collection was secretly moved, with police escort, to San Antonio aboard a specially-modified, smooth-riding passenger bus and placed in the renovated bunker.

By then plans were underway to construct a hurricane-proof sample vault and processing laboratory. The building planners had several years experience in curating Moon rocks and a good idea of what was needed. They had time to plan carefully and the politics of quarantine did not interfere with good science. The result, an annex added to building 31, was a laboratory constructed of chemically clean materials kept clean by high efficiency air filtration. The building seemed to have a personality all its own—it could automatically seal shut the air conditioning to the vault and gases coming into the cabinets in the event of an emergency. A trip into the sample vault was likened to a journey into the heart of an Egyptian pyramid by one journalist. All sample handling activities were codified in a set of procedures written specifically for use in the new building. The sample collection, then numbering 50,000 pristine samples and "used" samples, was placed in the vaults in 1979.

During the lean years of the early 1980s, the curatorial staff set up an in-house tool cleaning facility and operated a freon still (freon was a standard cleaning fluid before chlorofluorocarbons were implicated as destroyers of Earth's statospheric ozone). Opening of new cores was suspended for 6 years; however, slabbing of breccias in the search for "new" samples increased later in the decade.



Today, lunar rocks and soils are curated in a hurricane-proof laboratory in which every material from floor covering to electrical plugs has been scrutinized and selected for minimal contamination to lunar samples. Cleanliness is maintained by specialized air filtration and restriction of the materials and number of people allowed in the laboratory. NASA S-85-36332

1994 marks two technology upgrades. Tool and container cleaning is being changed to exclude environmentally-questionable freon in favor of new ultrapure water cleaning technology and electronic conversion and storage of paper documents begins. Expert oversight of the lunar sample operations continues but LAPST has been replaced by the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM).

The principal gains since the completion of a proper facility have been the ever-tightening control of sample inventory, security and accountability for a national treasure. This expertise, for which the Office of the Curator remains a recognized leader, was enabled by interactive computer technology. Over the years the staff has grown in competence and expertise, acquiring the ability to do tasks formerly performed by other organizations. The curatorial operation currently provides an efficient means for inspecting, selecting and delivering samples to the scientific community.

After 25 years experience sample curation has evolved to a methodical and efficient operation encompassing meteorites, cosmic dust and space-exposed hardware in addition to lunar samples—experience with a range of sample types upon which to build curation of new extraterrestrial samples. G. J. Wasserburg has kindly said, "This laboratory has established a model to the world for the handling and distribution of rare extraterrestrial materials. The scientific community is gratified to have this capability and skill available and is proud of the accomplishments of the Lunar Sample Curatorial Facility."

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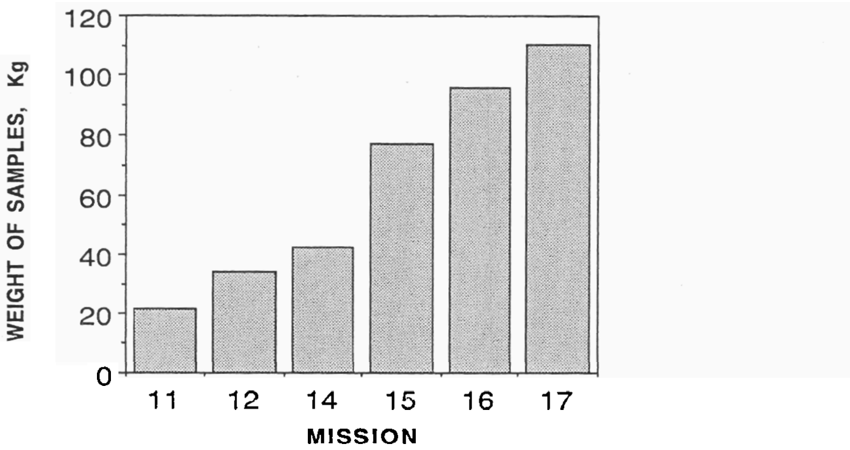
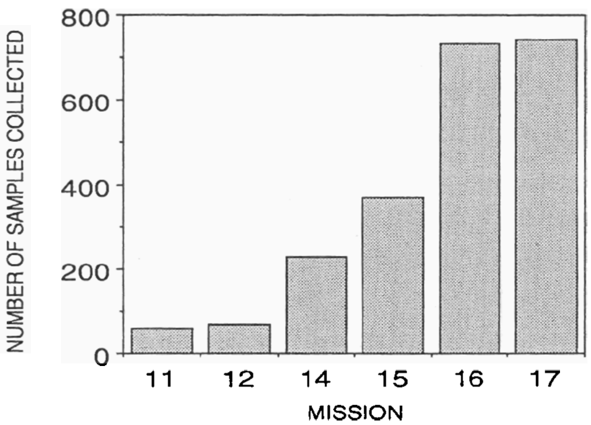
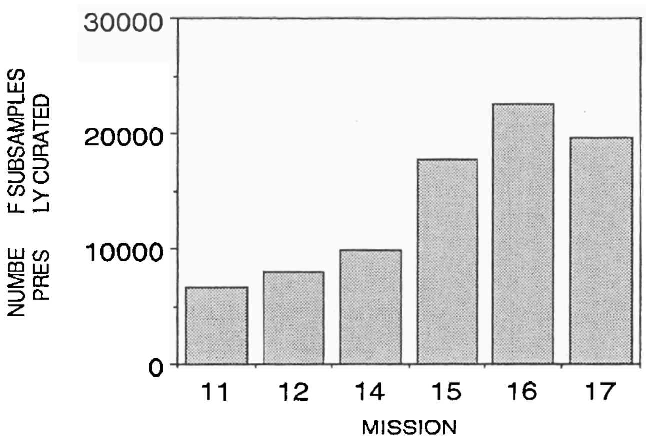






Miner's Daughter Looks Over the Moon

by Wendell Mendell
NASA/JSC

On February 19, 1994, a small United States spacecraft entered lunar orbit for the first time in 21 years to take scientific data on the Moon. Was this the mission for which lunar scientists had lobbied during two decades to "finish" the highly successful Apollo orbital geochemistry data set? Not exactly. In fact, the implementing agency was the Department of Defense and the Clementine spacecraft was officially designated as a flight qualification of "advanced lightweight technologies developed by the Ballistic Missile Defense Organization (BMDO)."

Fortunately for planetary science, the Antiballistic Missile (ABM) Treaty forbids testing these technologies in Earth orbit. The BMDO decided to head for the Moon and recruited a NASA-funded science team for advice on how to get the best science within the technical, operational, and fiscal constraints of the mission. The end result is two months of mapping from lunar polar orbit and a stunning remote sensing characterization of an entire planet.

Within a spacecraft dry mass of only 235 kg, Clementine's instruments included a UV/Visible Camera, Short- and Long-Wavelength Infrared Cameras, a Lidar Laser Transmitter coupled with a high-resolution camera, and a Star Tracker Camera. The science team chose a combination of 11 spectral filters for the UV/Visible Camera and the Near-Infrared Camera to maximize the ability to discriminate among lunar minerals. Careful choreography of the spacecraft's elliptical orbit has provided coverage for the entire Moon at a spatial resolution of 200-300 meters. Photographs of various locations by the lidar camera provide resolutions as high as 30 meters per pixel in five spectral bands.

The lidar instrument was modified to act as a laser ranging altimeter for the lunar mission. The instrument's capability to make the measurements had been questioned, but its performance exceeded all expectations. It returned a data set of lunar topography between latitudes 70N and 70S. The altimeter was turned off over the polar regions on the expectation that the altitude of the spacecraft there was too high. Nevertheless, since Clementine passed repeatedly over the poles, sufficient imaging exists to measure topography through the use of convergent stereo photography.

NASA plans to issue an announcement of opportunity to submit research proposals for data analysis later this year. Meanwhile, the science team is working to put the data in accessible form while assessing its content and quality. The altimetry data alone is giving startling information, proving the existence of several farside basins whose existence had only been proposed. In one case, a newly confirmed basin exhibits relief of 12 km from rim to floor! The South Pole region shows a permanently dark depression that may be as much as 150 km across. A difficult and complex measurement of the dielectric constant of this polar region using bistatic radar techniques is currently being analyzed to determine whether evidence for ice can be found.

Data from Clementine is already causing us to rethink our picture of lunar evolution. Yet, as exciting and voluminous as this new information is, we are still missing major data sets for planetary study such as global geochemistry, geophysical characterization of the internal structure, absolute ages of stratigraphic provinces, and even the most elementary information on the origin of lunar regional magnetism. As the Clementine data stream is processed into information, transformed into knowledge, and incorporated as understanding over time, it will raise new debates about the origin and evolution of the Earth-Moon system and spawn new concepts for further exploration of our sister planet. ❑

International Lunar Workshop 'Toward a World Strategy for the Exploration and Utilization of our Natural Satellite'

by Chuck Meyer
NASA JSC

Wendell Mendell, Dave McKay, Chuck Meyer and Mike Duke of JSC participated in the International Lunar Workshop hosted by the University of Bern and the European Space Agency (ESA) in Beatenberg, Switzerland May 31 to June 3, 1994 to consider future plans for internationally coordinated programs for robotic and human Lunar Exploration. The workshop considered scientific, technical, political and economic reasons why lunar exploration should be conducted as a coordinated and truly international venture. Working Groups considered current plans for lunar activities, transportation capabilities, political, legal and economic aspects, protection of the lunar environment, infrastructure, lunar site selection and the framework of international collaboration. The results of these working groups will be published in the Proceedings of the Workshop. Speakers at the workshop included: R.M. Bonnet, J. Geiss, H.H. Schmitt, H.S. Wolff, H. Bondi, J.M. Logsdon, Y. Langevin, J.-P. Swings, J. Rasool, R. Kouda, A. Kiss, P. Spudis, G. Giralt and M.B. Duke.

In his keynote address at the Workshop, Sir Hermann Bondi emphasized that 'Big Science' is necessarily linked to public affairs and that the Moon as a base is a proposal that is likely to be attractive in various ways: in the eyes of the public, in its engineering challenges, in the exploration of the Moon's potential for habitability and in its effectiveness as a base for scientific enterprises. It may well be the case that, on its own, no one of these arguments could justify the proposal, but that taken together there may be sufficient reason for a coordinated international program to go back to the Moon. Other speakers reviewed the state of knowledge of the Moon and what could be learned from a new lunar program. Paul Spudis, for example, presented Clementine data and Jack Schmitt forcefully presented a business plan for a hypothetical multinational company that would mine the Moon for He-3 as an energy source. John Logsdon reviewed the reasons for going to the Moon the first time. Mike Duke discussed the usefulness of the Moon as a stepping stone along the way toward a manned Mars mission.

At the end of the Workshop the following Declaration was issued:

"On the initiative of Switzerland and the European Space Agency, representatives from space agencies, scientific institutions and industry from around the world met in Beatenberg, Switzerland from 31 May to 3 June 1994 to consider plans for the implementation of internationally coordinated programs for robotic and human Lunar Exploration.

THE MEETING WAS ENTHUSIASTIC ABOUT THE RICH OPPORTUNITIES OFFERED BY THE EXPLORATION AND UTILIZATION OF THE MOON.

— The uniqueness of the Earth-Moon system was emphasized and the potential of the Moon as a natural long-term space-station was recognized.

— The Workshop agreed that the time was right, scientifically and technologically, for a staged lunar program implemented in evolutionary phases, the first phase involving science, technology, and resource exploration missions. The initial phases of the program, involving Moon orbiters and landers with roving robots, are within the capabilities of the individual space agencies technically and financially; but the benefits, scientifically and technologically, would be greatly enhanced by close coordination. Each phase should set the task for the next one, but will be fully justified on its own merits without being in any way dependent of the follow-on.

— Strong interest was expressed in the science of the Moon (illuminating the history of the Earth-Moon system), from the Moon (for astronomical projects), and on the Moon (biological reactions to low gravity and the unique radiation environment).

— The phased evolutionary approach allows the differences of opinion over the role of humans in space and the economic utilization of the Moon to be assessed later in the light of results from the earlier phases. As the program

progresses, it is possible that the attractions and benefits of human presence on the Moon will become clearly apparent. It is evident, however, that the Moon would represent the next logical step and a test bed in any plans of human expansion into the solar system.

— The Workshop concluded that existing launcher systems would permit the implementation of the initial phases. The significant technological advances required in areas such as robotics, telepresence, and teleoperations will certainly find scientific and industrial applications on Earth.

— The Workshop agreed that the objectives of the program can be accomplished while at the same time protecting the lunar environment.

— The Workshop concluded that current international space treaties provide a constructive legal regime within which to conduct peaceful scientific exploration and economic utilization of the Moon, including the establishment of permanent scientific bases and observatories.

In conclusion the Workshop agreed that this is the right time:

- *to begin the first phase of the lunar program*
- *to prepare for future decisions on the later phases*
- *to implement international coordination and cooperation*
- *to establish, at a working level, a mechanism for regular coordination of activities.*

In Europe, the Lunar Science Advisory Group, set up by ESA, has identified the scientific interest of returning to the Moon, addressing specifically the benefits of "Science of, on and from the Moon" in a study document titled "Mission to the Moon" ESA SP-1150 (1992). ESA has now developed a long-term strategy for lunar exploration based on a four-phased approach. In the ESA vision, the eventual goal of the fourth phase would be the realization of a human lunar outpost. During phase three, lunar resources would be developed and utilized. During phase two, a permanent robotic presence would be establish using robotic skills such as virtual-reality-type control. During the first phase, lunar explorer missions using existing technology and capability would be flown by various nations.

The scientific rationale for "A Moon Programme: The European View" is outlined in ESA BR-101 (May 1994), a portion of which is reproduced below:

"Science of the Moon"

"The Moon has preserved its primordial crust and is the most easily accessible location in the Solar System for studying the evolution of a natural planet immediately following accretion. It therefore holds the key to our understanding the early evolution of the Solar System. It also constitutes a natural laboratory in which general geological processes can be studied and understood."

"Following the Apollo and Luna programs, and more recently the Clementine project, our general knowledge and understanding of the Moon has improved dramatically. However, a number of major scientific themes have still to be investigated in greater depth, including: the origin of the Earth - Moon system, the thermal evolution and internal structure of the Moon, as well as its geochemistry, the impact-cratering history of the impact processes themselves, the formation of the regolith, the evolution of our Sun, through studying the record encapsulated in the lunar soil."

"Science on the Moon"

"The establishment of a lunar base would provide life scientists with challenging projects in the fields of exobiology, radiation biology, ecology and eventually also, with a manned presence, human physiology. In exobiology, studies on the Moon would contribute to our understanding of the principles leading to the origin, evolution and distribution of life. A laboratory on the Moon would allow the analysis of a wide variety of lunar samples and ... meteoritic material ...".

"The Moon also provides a unique laboratory for radiation-biology studies, with built-in sources of both electromagnetic and ionizing radiation, in which to investigate the biological importance of various components of cosmic and solar radiation. In preparing for the establishment of a human outpost on the Moon in the years to come, radiation monitoring, shielding, and solar-flare shelters must be studied, together with a reliable life-support system including biogeneration systems, as well as a health-monitoring system."

"Science from the Moon"

"The Moon is generally considered to be a unique astronomical site, offering better observing conditions than on Earth and with the unique advantage of affording access to the entire electromagnetic, particle and cosmic ray spectrum. The Moon is a large, stable and slowly rotating space platform, whose position and orientation are known exactly at all time. No thruster units are needed for "positioning" or "station-keeping", and instrument pointing is as simple as back on Earth. The far side of the Moon is the only place in the inner Solar System with a naturally 'clean' electromagnetic environment. One could also shield sensitive equipment from damaging radiation using the regolith material, and exploit the shadowed surface inside craters near the Moon's poles for siting of passively cooled instruments."

"The next step in astronomy will be the search for higher angular resolution, for the imaging of stars, galaxies and quasars, binary systems, and ultimately of extra-solar planets. This will eventually necessitate the construction of large antennas, telescopes, and interferometric systems on the Moon. Very-low-frequency (VLF) observations and interferometry in the ultraviolet to submillimeter spectral range will open new windows on the Universe, impacting on almost every field of astronomy. Although the Moon is not the only place in space where such observations are possible, kilometric sized (and larger) arrays and very large telescopes will most probably need to be sited on the lunar surface."

There is a lot of similarity of the European plan with the American Space Exploration Initiative (now cancelled), except that the early steps of the European plan would seem to be more achievable and the scientific rationale for the earlier phase is better stated. One of the main points made at the Lunar Workshop in Beatenberg was that an international effort should be affordable. The European plan will be presented to ESA this year and several candidates for the first lunar missions are apparently being developed in various countries.

There will be a Proceedings of the International Lunar Workshop containing the papers presented along with the results of the Working Groups. ❑

Apollo 17 Catalog Back on Track

We are pleased to announce that the fourth and final volume of the Catalog of Apollo 17 Rocks is well on its way to completion. Thanks to the dedicated efforts of Chuck Meyer, who agreed to serve as the new author, rock descriptions have been compiled for Volume 4 and drafts of the camera-ready page layouts are in progress. In addition, a cumulative index has been compiled to help readers locate rock descriptions, according to rock generic number, in each of the four volumes.

We expect that Volume 4 will be sent to printing in September 1994. Budget permitting, we plan to have printed copies available for mailing by early 1995, if not sooner.

To date, we have shipped copies of Volumes 1-3 to all of our customers who requested them. If you would like to receive any or all of the volumes, please send a written communication to us by mail, e-mail, or FAX at the corresponding address given on page 2. Be sure to provide your full mailing address.

To those of you who have asked about electronic versions of the catalog (e.g., CD-ROM platters), we regret that we are currently able to supply only papers copies. Although the Apollo 17 catalog was the first lunar sample catalog to be prepared in a modern desktop publishing environment, we do not have the resources to publish it in a multimedia format. ❑

Dissection of Core 68001 Is Complete

by Carol Schwarz
Lockheed Engineering & Sciences Company

Dissection of 68001, the bottom section of Apollo 16 double drive tube 68002/68001 has been completed. The core was dissected in 0.5-cm depth increments along three l-cm-thick longitudinal layers (passes) starting at the top of this section and continuing through the length (34. l cm) of the core. Soil from each increment of the first and third passes was separated into coarse and fine fractions using a l-mm sieve. The coarse particles were examined and photo-documented. Samples from the second or chemically pure pass were not sieved or examined in detail. Samples from all three passes are available now; thin sections are being prepared and will be available later this year.

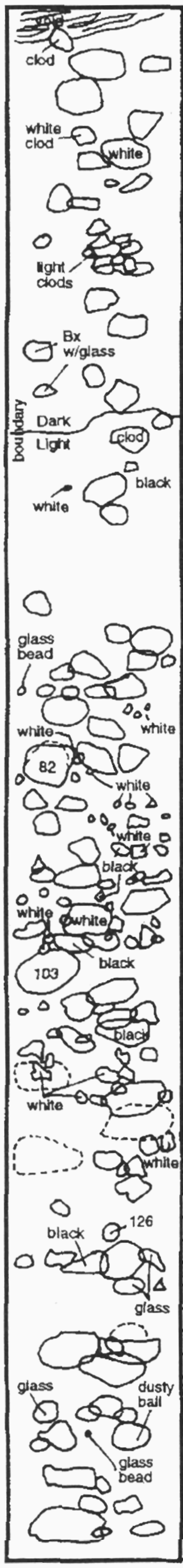
68001 was extruded on December 14, 1993. The length after extrusion was 34.1 cm; thus the total length of 68002/1 was 61 cm. The color of 68001 varied from 10YR 5/1 to 7/1 on the Munsell Color Scale and several distinct color boundaries were observed during the dissection passes. A void at the top end extended to about 1.5 cm. At 0 to about 9.0 cm was a dark layer, approximately 10YR 5/1. Dark soil breccias and soil clods were abundant and varied from small at the top to larger toward the lower end of this layer of the core. Black fine-grained glassy particles are abundant as well as some glass and anorthosites. From about 9.0 to 12.5 cm is a layer of lighter gray soil (10YR 7/1) characterized by light gray clods/soil breccias which dominate the >l-mm fraction. Anorthosites are rare and small black glassy particles are fairly numerous. At 12.5 cm and continuing to about 15 cm is a darker slightly bluish-gray layer. The >l-mm fraction consists of all coherent particles; they are generally small black glassy pieces, and breccias with a few anorthosites and glass. At about 15 cm the soil becomes a brownish-gray color (10YR 6/1) and is noticeably loose and coarse-grained. >l-mm particles are numerous and all are coherent (no friable soil breccias). A finger of light gray material extends about two thirds of the diameter of the core at about 18.0 - 18.5 cm with obvious mm-sized white fragments occurring. From about 21.5 cm and continuing to the bottom of the core is a lighter-colored zone of soil which is more coherent and whose >l-mm portion is rich in soil breccias (both clods and coherent breccias) and black glassy fine-grained fragments.

A close examination of particles >l-mm from the first and second dissection passes showed that about 81% (by number) of the particles are in the 1-2 mm size range, 18% were 2-4 mm, and 1% were 4-10 mm or >10 mm.

Lithology of the >l-mm fraction was determined by binocular microscopic examination of the particles from the first and second passes and is summarized as follows: 47% are various types of breccias and dusty fragments which were difficult to identify, 37% are black fine-grained glassy fragments, about 10% are white or light gray (anorthositic), 6% are glasses, and <1% are basalts. Among the 20 large or unusual particles >l mm which were given individual sample numbers are soil breccias, black glassy fragments, white fragments, and a small soil clod with a rusty-looking spot. Three samples of about .5g each were taken under red-light conditions from three depths of approximately 10, 20, and 30 cm.

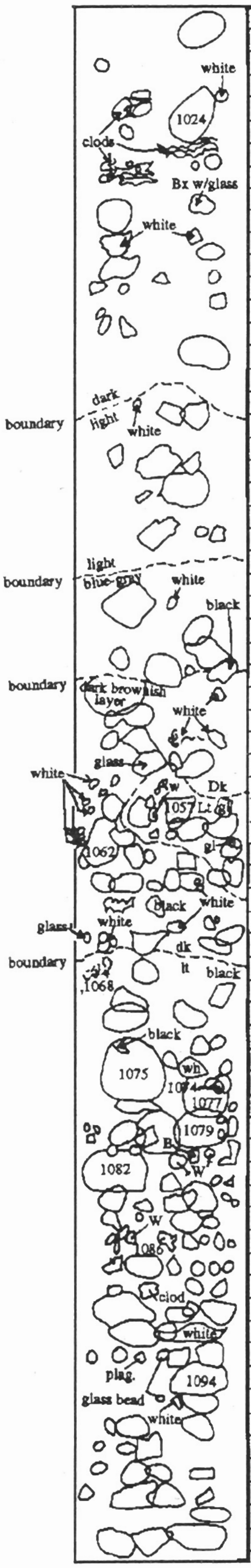
Diagrams for the three dissection passes follow and identify samples splits which are available for allocation. Weights are given in grams and "Bx" is used as an abbreviation for "breccia." ❑

DRIVE TUBE 68001 (First Dissection)



Depth (cm)	Depth from surface	<1 mm Fraction Sample No.	Wt.	>1 mm Fraction Sample No.	Wt.	Special Samples No.	Wt.	Type
0.5	27.2	12	.311	13	.017			
1.0	27.7	14	1.116	15	.071			
1.5	28.2	16	1.390	17	.232			
2.0	28.7	18	1.496	19	.242			
2.5	29.2	20	2.072	21	.175			
3.0	29.7	22	2.034	23	.325			
3.5	30.2	24	1.888	25	.356			
4.0	30.7	26	2.075	27	.375			
4.5	31.2	28	1.868	29	.259			
5.0	31.7	30	2.333	31	.267			
5.5	32.2	32	2.287	33	.352			
6.0	32.7	34	1.767	35	.335			
6.5	33.2	36	2.031	37	.229			
7.0	33.7	38	2.116	39	.435			
7.5	34.2	40	2.277	41	.276			
8.0	34.7	42	2.334	43	.383			
8.5	35.2	44	2.071	45	.325			
9.0	35.7	46	2.103	47	.480			
9.5	36.2	48 D	1.331	49 D	.134	50 L	.709	51 L .259
10.0	36.7	52	1.699	53	.467			
10.5	37.2	54	1.597	55	.328			
11.0	37.7	56	2.225	57	.384			
11.5	38.2	58	2.063	59	.367			
12.0	38.7	60	2.400	61	.198			
12.5	39.2	62	1.886	63	.200			
13.0	39.7	64	2.205	65	.180			
13.5	40.2	66	2.294	67	.294			
14.0	40.7	68	1.965	69	.234			
14.5	41.2	70	2.204	71	.405			
15.0	41.7	72	1.542	73	.662			
15.5	42.2	74	2.130	75	.765			
16.0	42.7	76	1.814	77	.449			
16.5	43.2	78	2.296	79	.672			
17.0	43.7	80	1.872	81	.565	82	.890	?
17.5	44.2	83	1.620	84	.508			
18.0	44.7	85	1.967	86	.483			
18.5	45.2	87	1.572	88	.476			
19.0	45.7	89	1.883	90	.743			
19.5	46.2	91	1.879	92	.784			
20.0	46.7	93	2.371	94	.669			
20.5	47.2	95	1.979	96	.609			
21.0	47.7	97	1.745	98	.665			
21.5	48.2	99	1.814	100	.406	103	.891	Breccia
22.0	48.7	101	1.960	102	.439			
22.5	49.2	104	1.968	105	.990			
23.0	49.7	106	1.813	107	.957			
23.5	50.2	108	1.922	109	.684			
24.0	50.7	110	1.804	111	.493			
24.5	51.2	112	1.734	113	.948			
25.0	51.7	114	1.614	115	.539			
25.5	52.2	116	1.338	117	.541			
26.0	52.7	118	1.996	119	.508			
26.5	53.2	120	2.083	121	.406			
27.0	53.7	122	2.063	123	.334			
27.5	54.2	124	2.057	125	.292	126	.025	clod w/ rust
28.0	54.7	127	2.195	128	.919			
28.5	55.2	129	2.017	130	.607			
29.0	55.7	131	1.931	132	.438			
29.5	56.2	133	1.888	134	.552			
30.0	56.7	135	1.425	136	1.128			
30.5	57.2	137	2.241	138	1.100			
31.0	57.7	139	2.320	140	.469			
31.5	58.2	141	1.715	142	.420			
32.0	58.7	143	2.313	144	1.068			
32.5	59.2	145	2.038	146	.367			
33.0	59.7	147	2.087	148	.53			
33.5	60.2	149	1.561	150	.500			
34.0	60.7	151	2.288	152	1.085			
34.1	60.8					153	1.083	sweepings

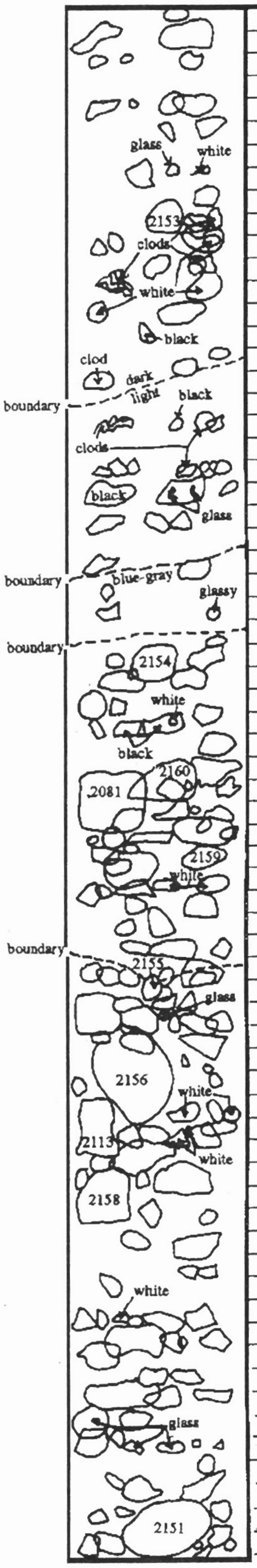
DRIVE TUBE 68001 (Second Pass)



Depth (cm)	Depth from surface
0.5	27.2
1.0	27.7
1.5	28.2
2.0	28.7
2.5	29.2
3.0	29.7
3.5	30.2
4.0	30.7
4.5	31.2
5.0	31.7
5.5	32.2
6.0	32.7
6.5	33.2
7.0	33.7
7.5	34.2
8.0	34.7
8.5	35.2
9.0	35.7
9.5	36.2
10.0	36.7
10.5	37.2
11.0	37.7
11.5	38.2
12.0	38.7
12.5	39.2
13.0	39.7
13.5	40.2
14.0	40.7
14.5	41.2
15.0	41.7
15.5	42.2
16.0	42.7
16.5	43.2
17.0	43.7
17.5	44.2
18.0	44.7
18.5	45.2
19.0	45.7
19.5	46.2
20.0	46.7
20.5	47.2
21.0	47.7
21.5	48.2
22.0	48.7
22.5	49.2
23.0	49.7
23.5	50.2
24.0	50.7
24.5	51.2
25.0	51.7
25.5	52.2
26.0	52.7
26.5	53.2
27.0	53.7
27.5	54.2
28.0	54.7
28.5	55.2
29.0	55.7
29.5	56.2
30.0	56.7
30.5	57.2
31.0	57.7
31.5	58.2
32.0	58.7
32.5	59.2
33.0	59.7
33.5	60.2
34.0	60.7
34.1	60.8

Unsieved Sample		Special Samples		
No.	Wt.	No.	Wt.	Type
1018	2.237			
1019	2.392			
1020	3.355			
1021	2.857			
1022	3.407			
1023	2.721	1024	.369	soil breccia
1025	3.446			
1026	3.365			
1027	3.510			
1028	3.414			
1029	3.546			
1030	2.628			
1031	2.857			
1032	3.689			
1033	2.934			
1034	2.647			
1035	3.240			
1036 D/L	1.581	1037L	2.041	
1038	3.039			
1039	2.652			
1040	3.587			
1041	3.036			
1042	3.168			
1043	3.452			
1044	3.673			
1045	3.321			
1046	3.316			
1047	3.147			
1048	2.841			
1049	3.291			
1050	2.714			
1051	4.195			
1052	2.579			
1053	3.354			
1054D	2.352	1055L	.589	
1056D	.941	1057L	2.205	
1058L	1.184	1059D	1.586	
1060L	.904	1061D	2.83	
1063	2.890	1062	.79	Anor. Bx?
1064	3.065			
1065	2.976			
1066	3.401			
1067	3.191	1068	.096	Anorthosite fgs
1069	3.105			
1070	3.374			
1071	2.466			
1072	2.325			
1073	1.878	1074	.140	Anorthosite fgs
1076	2.354	1075	1.157	lt. gray fg
1078	2.988	1077	.954	soil Bx?
1080	2.908	1079	1.062	soil Bx?
1081	2.188	1082	3.154	black fg
1083	3.215			
1084	3.592			
1085	3.734	1086	0.065	glass
1087	3.139			
1088	3.478			
1089	4.074			
1090	4.083			
1091	3.319			
1092	2.250	1094	.698	dusty glass
1093	3.607			
1095	3.430			
1096	3.778			
1097	3.213			
1098	3.623			
1099	3.242			
1100	4.176	1101	1.727	sweepings

DRIVE TUBE 68001 (Third Pass)



Depth (cm)	Depth from surface	<1 mm Fraction Sample No.	Wt.	>1 mm Fraction Sample No.	Wt.	Special Samples No.	Wt.	Type
0.5	27.2	2007	2.836	2008	.268			
1.0	27.7	2009	2.986	2010	.572			
1.5	28.2	2011	2.300	2012	.248			
2.0	28.7	2013	2.628	2014	.245			
2.5	29.2	2015	3.122	2016	.443			
3.0	29.7	2017	2.420	2018	.277			
3.5	30.2	2019	3.006	2020	.357			
4.0	30.7	2021	3.574	2022	.373			
4.5	31.2	2023	2.624	2024	.294			
5.0	31.7	2025	2.615	2026	.454	2153	.353	Breccia?
5.5	32.2	2027	2.316	2028	.304			
6.0	32.7	2029	2.816	2030	.333			
6.5	33.2	2031	2.607	2032	.283			
7.0	33.7	2033	2.721	2034	.423			
7.5	34.2	2035	2.865	2036	.378			
8.0	34.7	2037	2.799	2038	.441			
8.5	35.2	2039	2.708	2040	.323			
9.0	35.7	2041	2.456	2042	.386			
9.5	36.2	2043	2.771	2044	.748			
10.0	36.7	2045	2.479	2046	.521	2047	.5	Pre-red light
10.5	37.2	2049	2.268	2050	.355	2048	.614	Red light
11.0	37.7	2051	2.774	2052	.734			
11.5	38.2	2053	2.665	2054	.387			
12.0	38.7	2055	2.226	2056	.342			
12.5	39.2	2057L	.715	2058L	.226	2059D	2.632	2060D .337
13.0	39.7	2061	3.07	2062	.422			
13.5	40.2	2063	4.000	2064	.302			
14.0	40.7	2065	2.207	2066	.231			
14.5	41.2	2067	2.053	2068	.280	2154	.254	Breccia?
15.0	41.7	2069	2.605	2070	.597			
15.5	42.2	2071	2.254	2072	.488			
16.0	42.7	2073	2.757	2074	.754			
16.5	43.2	2075	2.558	2076	.544			
17.0	43.7	2077	2.167	2078	.555	2160	1.372	Anorthosite
17.5	44.2	2079	2.665	2080	.889	2081	.745	Breccia?
18.0	44.7	2082	2.34	2083	1.365			
18.5	45.2	2084	1.860	2085	1.303			
19.0	45.7	2086	2.361	2087	1.435	2159	.098	Black dusty fg
19.5	46.2	2088	1.912	2089	1.191			
20.0	46.7	2090	2.842	2091	1.190			
20.5	47.2	2093	2.328	2094	.484	2092	.667	Red-light
21.0	47.7	2095	2.893	2096	.721	2155	.153	Glass?
21.5	48.2	2097	2.438	2098	.993			
22.0	48.7	2099	2.180	2100	.930			
22.5	49.2	2101	2.514	2102	1.217			
23.0	49.7	2103	2.946	2104	1.023	2156	9.651	Black fg
23.5	50.2	2105	1.064	2106	.242	2157	.247	fi from ,2156
24.0	50.7	2107	1.325	2108	.303			
24.5	51.2	2109	2.087	2110	.542			
25.0	51.7	2111	2.778	2112	.741	2113	.485	Black, vesicular
25.5	52.2	2114	2.348	2115	.857			
26.0	52.7	2116	2.579	2117	.833	2158	1.265	Dusty Glass
26.5	53.2	2118	2.551	2119	.282			
27.0	53.7	2120	2.955	2121	.388			
27.5	54.2	2122	2.530	2123	.770			
28.0	54.7	2124	2.777	2125	.398			
28.5	55.2	2126	3.120	2127	.494			
29.0	55.7	2128	2.369	2129	.774			
29.5	56.2	2130	2.211	2131	.952			
30.0	56.7	2132	2.066	2133	.588			
30.5	57.2	2135	2.498	2136	.437	2134	.482	Red-light
31.0	57.7	2137	2.161	2138	.671			
31.5	58.2	2139	2.501	2140	.735			
32.0	58.7	2141	2.655	2142	.762			
32.5	59.2	2143	2.582	2144	.391			
33.0	59.7	2145	2.516	2146	.592	2151	1.761	Glassy?
33.5	60.2	2147	2.089	2148	.403	2152	.302	fines from ,2151
34.0	60.7	2149	2065	2150	.561	2162	2.380	sweepings
34.1	60.8							

How to Request Lunar Samples

NASA policies define lunar samples as a limited national resource and future heritage and require that samples be released only for approved applications in research, education, and public display. To meet that responsibility, NASA carefully screens all sample requests with most of the review processes being focused at the Johnson Space Center (JSC). Any and all individuals requesting a lunar sample should follow the steps given below for the appropriate category of sample.

1. RESEARCH SAMPLES (including thin sections)

NASA provides lunar rock, soil, and regolith-core samples for both destructive and non-destructive analysis in pursuit of new scientific knowledge. Requests are considered for both basic studies in planetary science and applied studies in lunar materials beneficiation and resource utilization.

A. The sample investigator demonstrates favorable scientific peer review of the proposed work involving lunar samples. The required peer review can be demonstrated in any one of three ways: (1) A formal research proposal recommended by the Lunar and Planetary Geosciences Review Panel (LPGRP) within the past three years; (2) A formal research proposal recommended by the Indigenous Space Resources Utilization (ISRU) panel for work pertaining to the specific sample request (step B); (3) Submittal of reprints of scientific articles pertaining directly to the specific research methods to be applied to the samples (step B), and published in peer-reviewed professional journals.

B. The investigator submits a written request specifying the numbers, types, and quantities of lunar samples needed as well as the planned use of the samples. For planetary science studies, the sample request should be submitted directly to the Lunar Sample Curator at the following address:

Dr. James L. Gooding
Lunar Sample Curator
SN2
NASA/Johnson Space Center
Houston, TX 77058-3696
USA
Fax: (713) 483-2911

For engineering and resource-utilization studies, the sample request should be submitted to the Lunar Simulant Curator at the following address:

Dr. Douglas W. Ming
Lunar Simulant Curator
SN4
NASA/Johnson Space Center
Houston, TX 77058-3696
USA
Fax: (713) 483-5347

The Lunar Simulant Curator will arrange for an ISRU review of the applications-oriented sample request to assure that all necessary demonstration tests with simulated lunar materials have been satisfactorily completed. Requests determined to be sufficiently mature to warrant consideration for use of lunar materials will then be forwarded to the Lunar Sample Curator.

For new investigators, tangible evidence of favorable peer review (step A) should be attached to the sample request. Each new investigator should also submit a résumé.

Investigators proposing the application of new analytical methodologies (not previously applied to lunar samples) also should submit test data obtained for simulated lunar materials. New investigators who are not familiar with lunar materials should consult *Lunar Sourcebook: A User's Guide to the Moon* (G. Heiken, D. Vaniman, and B. M. French, Eds.; Cambridge University Press, 736 pp.; 1991; ISBN 0-521-33444-6) as the best available reference on the chemical and physical properties of lunar materials.

C. The Lunar Sample Curator will research the availability of the requested samples and decide whether a unilateral action can be taken or an outside scientific review is required. Outside review is prescribed for all new investigators and for most established investigators except where returned (previously used) samples are being requested. For outside review, the Curator forwards the original request, with background information, to the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM), a standing committee of scientists who advise NASA on the care and use of lunar samples. CAPTEM checks for favorable peer review (step A) and appropriate sample selection (step B).

Accessing the JSC SN2 Curatorial Data Bases

The curatorial databases may be accessed as follows:

Via DECNET	1) Log onto your host computer. 2) Type **SET HOST 9300** at the system prompt. 3) Type **PMPUBLIC** at the USERNAME: prompt. NOTE: Your system manager may add node CURATE to the DECNET database on your host computer; the SPAN node number is 9.84. You may then access CURATE by typing **SET HOST CURATE** instead of **SET HOST 9300**.
Via INTERNET	1) Type **TELNET 139.169.126.35** or **TELNET CURATE.JSC.NASA.GOV**. 2) Type **PMPUBLIC** at the USERNAME: prompt.
Via modem	The modem may be 300, 1200, or 2400 baud; no parity; 8 data bits; and 1 stop bit. If you are calling long distance, the area code is 713. 1) Dial 483-2500. 2) Type **SN_VAX** in response to the Enter Number: prompt. 3) Hit <CR> 2 or 3 times after the CALL COMPLETE message. 4) Type **J31X** in response to the # prompt. 5) Type **PUBLIC** in response to the Enter Username> prompt. 6) Type **C CURATE** in response to the Xyplex> prompt. 7) Type **PMPUBLIC** at the USERNAME: prompt.

For problems or additional information, you may contact:

Claire Dardano
Lockheed Engineering & Sciences Company
(713) 483-5329

D. Given CAPTEM endorsement and concurrence by NASA Headquarters, the Lunar Sample Curator will prepare a Lunar Sample Loan Agreement for signature by the investigator's institution. The agreement includes a simple security plan that prescribes precautions to minimize prospects for theft or unauthorized use of lunar samples.

E. Upon receipt of the properly executed loan agreement, the Lunar Sample Curator prepares the authorized samples and sends them to the investigator. Quantities less than 10 grams can be sent directly by U. S. registered mail to domestic investigators. Shipments to foreign investigators are sent by U. S. diplomatic pouch mail to the American embassy nearest the requestor's location. Quantities larger than 10 grams must be hand-carried by the investigator or his/her representative.

F. Continuation as a Lunar Sample Investigator. An investigator's privilege for retention and use of lunar samples is contingent upon continued good standing with the Office of the Curator. The investigator will remain in good standing by fulfilling the following obligations: (1) Maintenance of, and adherence to, the lunar sample loan agreement and security plan; (2) Timely cooperation with annual lunar sample inventory; (3) Timely cooperation with sample recalls.

2. PUBLIC DISPLAY SAMPLES

NASA provides for a limited number of rock samples to be used for either short-term and long-term displays at museums, planetariums, expositions, or professional events that are open to the public. Requests for such display samples are administratively handled by the JSC Public Affairs Office (PAO). Requestors located in the United States should apply in writing to the following address:

Mr. Boyd E. Mounce
Lunar Sample Specialist
AP4/Public Services Branch
NASA/Johnson Space Center
Houston, TX 77058-3696
Fax: (713) 483-4876

Requestors in foreign countries must contact the public affairs officer of the United States Information Service (USIS) at the nearest American embassy. The USIS will contact Mr. Mounce to determine whether the loan of a display sample is appropriate.

For both domestic and foreign requestors, Mr. Mounce will advise successful applicants regarding provisions for receipt, display, and return of the samples. All loans will be preceded by a signed loan agreement executed between NASA and the requestor's organization. Mr. Mounce will coordinate the preparation of new display samples with the Lunar Sample Curator.

3. EDUCATIONAL SAMPLES
(disks and educational thin sections)

A. Disks

Small samples of representative lunar rocks and soils, embedded in rugged acrylic disks suitable for classroom use, are made available for short-term loan to qualified school teachers. Each teacher must become a certified user of the disks through a brief training program prior to receiving a disk. Educational sample disks are distributed on a regional basis from NASA field centers located across the United States. For further details, prospective requestors should contact the public affairs office at the nearest NASA facility or write to the following address:

Mr. Larry B. Bilbrough
FEE/Elementary and
Secondary Education
NASA Headquarters
Washington, DC 20546
Fax: (202) 358-3048

B. Thin Sections

NASA prepared thin sections of representative lunar rocks on rectangular 1 x 2-inch glass slides, with special safety frames, that are suitable for use in college and university courses in petrology and microscopic petrography for advanced geology students. Each set of 12 slides is accompanied by a sample disk (described above) and teaching materials. The typical loan period is two weeks, including round-trip shipping time. Each requestor must apply in writing, on college or university letterhead, to the following address:

Lunar Sample Curator
SN2
NASA/Johnson Space Center
Houston, TX 77058-3696
Fax: (713) 483-2911

For each approved user, the Curator will prepare a loan agreement to be executed between NASA and the requestor's institution prior to shipment of the thin-section package.